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Two New Crustaceans: The Parasitic Copepod *Sphaeronellopsis monothrix* (Choniostomatidae) And its Myodocopid Ostracod Host *Parasterope pollex* (Cylindroleberidae) From the Southern New England Coast

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The parasitic copepods of the family Choniostomatidae have received little attention since the classic monograph of Hansen (1897). This neglect is probably attributable to the fact that the majority of them inhabit the marsupia of other crustaceans, mostly Peracarida, where they easily are mistaken for the eggs of the hosts and therefore are overlooked. The abundance of the new choniostomatid considered in this paper suggests that these copepods are more common than generally is realized.

The new choniostomatid described herein, *Sphaeronellopsis monothrix*, was discovered by Kornicker during a study of a new species of ostracod, *Parasterope pollex*, from Hadley Harbor, near Woods Hole, Mass. The description of *P. pollex* has been prepared by Kornicker alone, while that of *S. monothrix* is the work of both authors.

The material available has been sufficient to enable us to give some details of the biology of *S. monothrix* and its relations with the host. Following this account are formal taxonomic descriptions of both species.

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The station data for the collections of ostracods used in this study are as follows:

station	*locality*	*date/time*	*depth m*	P. pollex *number per sample*
1907	Hadley Harbor, Woods Hole, Mass. block 137	July 13, 1965 0945 hrs.	1	63
2906	Hadley Harbor, " block 111	July 7, 1965 1440 hrs.	2	170
Coll. 1	Lake Tashmoo, Martha's Vineyard, Mass.	Nov. 13, 1962		1
Coll. 2	Lake Tashmoo, "	Nov. 13, 1962		1
Coll. 4	Lake Tashmoo, "	Nov. 13, 1962		
–	Great Harbor, Woods Hole, Mass.	Sept. 12, 1962	5	1
260	Hadley Harbor, "	Apr. 27, 1965	1–2	44
270	Hadley Harbor, "	May 4, 1965	1	4
276	Hadley Harbor, "	May 25, 1965	1	95
2207	Hadley Harbor, "	July 13, 1965	6	4
1	Stonewall Pond, Chilmark, Martha's Vineyard, Mass.	July 1965	2	27
6	Stonewall Pond, Chilmark, "	July 1965	3	9
7	Lagoon Pond, Vineyard Haven, "	July 1965	2	10

We are grateful to Dr. Roland L. Wigley, Bureau of Commercial Fisheries Biological Laboratory, Woods Hole, Mass., for ostracods from Great Harbor and Lake Tashmoo; to Mr. J. Stewart Nagle, Marine Biological Laboratory, Woods Hole, for ostracods from Hadley Harbor, and to Mrs. C. R. Stoertz, Department of Paleobiology, Smithsonian Institution, for ostracods from stations 1, 6, and 7 from Martha's Vineyard. We thank Mrs. Carolyn Bartlett Gast for final preparation of the ostracod figures from camera lucida drawings by Kornicker.

LIFE HISTORY OF *Sphaeronellopsis monothrix*.—From the specimens in our collections (p. 3) it is possible to reconstruct some details of the life history. It is obvious from the account that follows that our knowledge of many phases of the life history is either fragmentary or completely lacking. We hope that the ready availability of the species at Woods Hole and perhaps elsewhere on the Atlantic Coast will lead others to investigate more intensively the biology of this interesting parasite.

The motile stage by which *Sphaeronellopsis* spreads from one ostracod to another is the copepodid, which swims by means of the 2 pairs of flat, setose trunk legs. Copepodids found in an ostracod marsupium without accompanying adult copepods or ovisacs are interpreted as recently having invaded the hosts. Since they do not differ in size or morphology from copepodids still within the ovisac membrane, there appears to be only one copepodid instar. The copepodid normally does not enter immature ostracods; we have not found any infestation in female ostracods less than 1.30 mm long.

Spermatophores were attached to 2 female copepods, .23 and .36 mm in length, indicating that mating may take place when the female is very young or may be delayed until she is older. Only 3 male

copepods were found, suggesting that the life span of the male is much less than that of the female.

Ostracods that already have laid a clutch of eggs are not attacked. The only parasitized ostracod with its own eggs in its marsupium was a specimen containing copepodids. The susceptible period for the ostracod is the time following its final molt and preceding egg deposition. Once it is in the marsupium, the presence of the copepod inhibits egg laying by its host. Only 1 female *Sphaeronellopsis* develops in an ostracod, but more than 1 male may be found in a single host.

Sphaeronellopsis eggs are not laid singly, but in groups, each of which is enclosed by a membrane. All the eggs in 1 ovisac are at the same developmental stage, but those in different ovisacs may be in different stages. We have divided the eggs arbitrarily into 3 categories, according to the stage of development (pl. 1*d–f;* list below): spherical eggs, pyriform eggs, and copepodids still within the ovisac membrane. Several batches of eggs must be laid at intervals, since ovisacs with all 3 stages may occur together. Each ovisac contains about 15 eggs, and up to 8 ovisacs (about 120 eggs) in one stage have been found in an ostracod. The total number of eggs produced by a female must be at least 3 x 120 or 360, and perhaps more, since it is possible that more than 3 clutches of eggs are laid.

DATA ON SPECIMENS OF *Sphaeronellopsis monothrix* (the 3 types of ovisacs are shown in pl. 1*d–f*). —

		copepods			*number of ovisacs*		
sex of ostracod host	*station*	*length of female*	*number of males*	*number of copepodids*	*spherical*	*pyriform*	*copepodid*
♀ [a]	1907			2			
♀	"	.36			8	4	
♀	"	.32				2	2
♀	"	.39			3	3	1
♀	"	.35		5		7	1
♀	"	.33				2	2
♀	"	.37			2		1
♀	"	.33	1		5		
♀	"	.34				1	2
♀	"	.40	2	1	5	4	
♀	"	.40			7		
♀	"	.36 [b]			5	3	
♂	"			1			
♀	2906	.40			6		
♀	"	.36					
♀	"	.30					
♀	"	.24					
♀	"	.30					

See footnotes at end of table.

		copepods			number of ovisacs		
sex of ostracod host	station	length of female	number of males	number of copepodids	spherical	pyriform	copepodid
♀	2906	.47					
♀	"				5		
♀	"				3		
♀	"	.25					
♀	"	.42					
♀	"			2	3		
♂	"	.33					
juv. ♂	Coll. 4	.23 [b]					

[a] Ostracod eggs present.
[b] Spermatophore attached.

INCIDENCE OF PARASITISM.—In spite of the similarity in size, the female *Sphaeronellopsis* and her ovisacs are readily distinguishable from ostracod eggs thru the valves of undissected preserved specimens. The female *Sphaeronellopsis* has a characteristic yellow color, and her ovisacs are less uniform in appearance than ostracod eggs. The smaller and more transparent copepodids are more difficult to see altho some were visible in intact ostracods. No male copepods were discovered in undissected ostracods.

Specimens appearing to have parasites were examined after being cleared in glycerine to be rendered more visible. To increase the reliability of the search, additional ostracods in which copepods had not been seen in the preliminary examination were also examined in glycerine, but this supplementary examination revealed very few additional parasites. In all, 86 ostracods were examined in glycerine, and in about half of these the shell was removed.

Of the 407 ostracod specimens, including juveniles and adults, 25, or nearly 1 out of 16, were found to be parasitized. Since juveniles normally are not parasitized (all of the 95 juveniles from station 276 were free of copepod parasites), the degree of infestation of adults is more significant biologically. Our most reliable data is from the station 2906 collection of 170 ostracods, which includes about 141 adult females (15 with marsupial eggs), 6 adult males, and 23 juveniles. Ten of the females and 1 of the males were parasitized, i.e., about 1 out of 13 adults. The success of the parasitism is evident when it is considered that the copepod eggs being brooded by the ostracods outnumber their own eggs. A female *Parasterope* seldom has more than 13 eggs in her marsupium, less than the number in 1 copepod ovisac.

HOST SPECIFICITY.—*Sphaeronellopsis monothrix* has been found only in *Parasterope pollex*. One other myodocopid ostracod, *Sarsiella zostericola*, is abundant in Hadley Harbor; 17 specimens, including 8 adult females, 1 adult male, and 8 juveniles have been examined for sphaeronellids with negative results. It is noteworthy that in

collections from Lyttleton Harbor, New Zealand, Hansen (1905) found *Sphaeronellopsis littoralis* in *Sarsiella hispida* but not in the much more abundant *Sarsiella hanseni*.

EFFECTS OF PARASITISM ON THE HOST.—We have observed no differences between parasitized and nonparasitized ostracods in the structure of the shell or the body and its appendages. As Hansen (1897) has pointed out, choniostomatids apparently feed by piercing the host's integument with pointed mandibles and sucking its blood with the aid of the funnel-shaped mouth cone. The effect of this feeding on the ostracod is unknown. The most serious effect of the *Sphaeronellopsis* appears to be the inhibition of ovulation by the host. Only 1 of the 23 parasitized female ostracods had laid its own eggs in its marsupium. Conversely, the copepod seems to be deterred from entering the marsupium of an ostracod that is incubating its own eggs; 16 of the 17 ostracods with their own eggs in their marsupia were not parasitized.

These observations are similar to those of Hansen (1897), who reported that in studying the 38 species of choniostomatids living in crustacean marsupia, he found almost 160 cases of marsupia with parasites and no host eggs, but only 6 cases wherein parasites and host eggs occurred together.

EGG MIMICRY IN THE CHONIOSTOMATIDAE.—The similarity in size of *Sphaeronellopsis* ovisacs and the eggs of the ostracod host is more than coincidental. While the individual *Sphaeronellopsis* eggs are much smaller (diameter about .07 mm) than the ostracod eggs, they are grouped into clusters of about 15 eggs; the diameter of the clusters usually falls between .20 and .30 mm, about the same as that of the ostracod eggs. This similarity in size clearly seems to be a case of egg mimicry having adaptive value for the *Sphaeronellopsis*. The 3rd thoracic legs of myodocopid ostracods are very flexible, adapted for removing foreign particles from the interior of the valves and from the eggs (Skogsberg, 1920, p. 88, ftn.). Individual copepod eggs presumably would be removed from the brood chamber by the cleaning leg, but the copepod avoids this hazard by laying its eggs in groups within sacs, each sac mimicking 1 of the ostracod eggs in size and shape. Instead of being removed as a foreign particle, the *Sphaeronellopsis* ovisac is retained within the brood chamber and cleaned by the host with the same solicitude given to its own eggs. To a male ostracod, however, an ostracod egg or a *Sphaeronellopsis* ovisac mimicking an ostracod egg is a foreign particle and therefore is removed by the cleaning leg. It is significant that in the few instances in which a female *Sphaeronellopsis* was found in a male ostracod, no ovisacs were present.

Altho 38 of the 43 species dealt with by Hansen in his classic 1897 monograph inhabit the marsupia of Amphipoda, Isopoda, Cumacea, and Mysidacea, Hansen did not call attention to the similarity in size between the eggs of the host and the ovisacs of the choniostomatid parasites. The above peracarid crustaceans aerate and keep their eggs free of contaminating particles by circulating a current of water thru the marsupium by movements of the pleopods (gammaridean Amphipoda), maxillipeds (Isopoda, Cumacea), or oostegites (Tanaidacea, Isopoda, caprellid Amphipoda). There is no flexible appendage that can reach into the marsupium and handle the eggs individually, except possibly in the Mysidacea (Jancke, 1924); hence, mimicry of the eggs of these Crustacea is not needed to prevent them from ejecting the eggs of their choniostomatid parasites. Individual copepod eggs, however, because of their small size, would be in danger of being flushed from the marsupium by the circulating water current, whereas ovisacs similar in size to the host's eggs are too large to encounter this risk. Thus it is advantageous to the choniostomatid to lay its eggs in groups rather than singly.

A further advantage to the parasite in having its ovisacs resemble the host's eggs is that the parasitized host does not become more conspicuous and thus more vulnerable to predators than in the normal ovigerous condition. This advantage only operates when the marsupial contents are visible, and is probably much less significant in ostracods, in which the shell obscures the eggs, than in crustaceans with transparent oostegites. Della Valle (1893) pointed out that the ovisacs of species of *Sphaeronella* infesting the amphipods *Ampelisca diadema* and *Microdeutopus gryllotalpa* matched the color of the host's eggs. This predator-deceiving egg mimicry, to be distinguished from the host-deceiving egg mimicry in *Sphaeronellopsis monothrix*, is also characteristic of marsupial parasites that are too large or firmly attached to be dislodged by the host. Crytoniscid isopods (species summarized recently by Nielson and Stromberg, 1965) are in this category. Whether the host behaves normally in ventilating and cleaning the contents of its marsupium when it is occupied by a predator-deceiving parasite instead of its own eggs is not known.

Sphaeronellopsis Hansen, 1905

Sphaeronellopsis monothrix Bowman and Kornicker, new species

FIGURES 1–3

FEMALE.—Length .23–.47 mm. Head well defined from trunk, relatively large. Trunk wider than long in fully developed female, narrower than long in young female, ventral surface with a number of rows of minute hairs. Submedian skeleton of head well developed;

longitudinal bar on each side, divided posteriorly, has strong bar extending laterad between 2nd maxilla and maxilliped; focusing shows this lateral bar to be folded as it passes anteriad and reaches base of 2nd maxilliped.

1st antenna 2-merous; proximal segment long, well provided with setae as shown in figure 1*b*, bearing distally a long esthete; 2nd segment short, with 2 apical setae. 2nd antenna absent. 1st maxilla with 2 processes, directed anteriad and laterad. 2nd maxilla apparently 2-merous; proximal segment robust with row of surface spinules, produced distally into lobe overlapping medial surface of distal segment; distal segment with apex ending in 2 teeth. Maxilliped 3-merous; 1st segment without ornamentation; 2nd segment with short blunt distal spine; distal segment short, conical, entire.

Legs and caudal rami composed of single short cylindrical segment bearing a single terminal seta with swollen base.

Boundaries of genital area not evident. Genital apertures broadly U-shaped, located lateral to and slightly anterior to caudal rami. Seminal receptacles oval.

MALE.—Length .11 to .13 mm. Body chunky, about ⅞ as broad as long and nearly ⅞ as high as long. Head somewhat more than ½ total body length; anterior margin smoothly rounded, lateral margins evenly convex; greatest width at level of bases of 2nd maxilla; dorsum bare except for row of hairs on posterior part of each lateral margin. Trunk much narrower than head, tapering posteriorly to rather narrow obtuse apex, densely clothed with long hairs.

1st antenna essentially like that of female, but apparently 1-merous since suture could not be discerned. 2nd antenna absent. 1st maxilla with 2 processes. 2nd maxilla with serrulate ridge on proximal segment; lobe at base of claw with serrulate margin; terminal claw undivided at apex. Maxilliped reaching back nearly to posterior end of trunk, like that of female. Trunk legs apparently absent. Caudal ramus like that of female.

COPEPODID.—Length 0.17 mm. Prosome oval, nearly 3½ times as long as urosome. Front with U-shaped list with arms extending over bases of 1st antennae. Pouch pointed, reaching base of second trunk legs. 1st urosomite with V-shaped ridge on ventral surface, arms of V leading to bases of ventral pair of setae. Ventral setae only slightly shorter than dorsal setae. 2nd urosomite about as long as 1st and as broad as posterior part of 1st. 3rd urosomite fused ventrally but not dorsally with caudal rami. Caudal rami with 1 pair of robust medial setae, nonplumose and more than twice as long as urosome, and 3 pairs of shorter lateral setae.

1st antenna 3-merous; 1st segment with 2 setae; 2nd segment short, unarmed; 3rd segment with the usual pair of long apical setae and 6

additional setae; esthete more than 3 times as long as appendage. 2nd antenna 3-merous; 3rd segment with long terminal seta and shorter setae near proximal end. 1st maxilla like that of female, with 2 processes. 2nd maxilla 3-merous; 1st segment with 3 rows of fine serrations; 2nd segment with a few serrations distally; 3rd segment with denticulate inner margin, apex like that of female. Maxilliped 4-merous; 1st segment longer than combined remaining segments, with longitudinal row of serrations.

Swimming legs 2 pairs, identical. Exopod with 3 outer spines, 2 terminal setae, and 2 inner setae. Endopod lateral margin with a row of spiniform teeth and a subterminal spine; medial margin with 6 plumose setae.

TYPES.—Holotype female, length .33 mm, from marsupium of adult female *Parasterope pollex*, length 1.55 mm, station 1907, Hadley Harbor, Woods Hole, Mass., USNM 119122. The other specimens listed on pages 3–4 are paratypes.

ETYMOLOGY.—The specific name "monothrix," from the Greek "mono"=one and "thrix"=hair, refers to the single apical seta of the trunk legs and caudal rami.

RELATIONSHIPS.—We have placed the new species in the genus *Sphaeronellopsis* in spite of its lacking the following characters that Hansen (1905) considered to be among the most distinctive for the genus (Hansen had only females): caudal rami fused, genital area with broad anterior protuberance, seminal receptacles long and strongly curved. Because of the absence of these characters, a reasonable case could be made for assigning *S. monothrix* to *Sphaeronella* rather than to *Sphaeronellopsis*; however, the new species does agree with *Sphaeronellopsis littoralis*, until now the only species of the genus, in having a 2-merous 1st antenna, no 2nd antenna, a 3-merous maxilliped with a short terminal segment, and single terminal setae on the trunk legs and caudal rami. The factor that induced us to place our species in *Sphaeronellopsis* rather than in *Sphaeronella* is that both *S. littoralis* and *S. monothrix* are parasites of ostracods. Even if *S. monothrix* were placed in *Sphaeronella* now, it would probably be transferred to *Sphaeronellopsis* later, since the species of Sphaeronella are quite diverse, and eventually it will probably be necessary to subdivide the genus. Hansen (1898) may have anticipated such a subdivision, for he divided the species of *Sphaeronella* according to their morphology into 2 main groups, one made up of parasites of amphipods, the other consisting of parasites of cumaceans.

We have recently described (Bowman and Kornicker, in press) a choniostomatid from the ostracod *Pseudophilomedes ferulana* Kornicker. Only copepodids were found, and their characters agree with

those given by Hansen (1897) for *Sphaeronella*. The copepodid of *Sphaeronellopsis* being unknown, we assigned the *Pseudophilomedes* parasite provisionally to *Sphaeronella*. When adults are discovered, it may become necessary to reassign it to the genus *Sphaeronellopsis*. It differs from the copepodid of *S. monothrix* most noticeably in the structure of the 2nd maxilla and maxilliped, especially in the lack of serrations on the 1st segment of the latter.

Because *S. monothrix* in some respects is intermediate between *Sphaeronellopsis* and *Sphaeronella*, it is useful to compare it with species of the latter genus. The female of *S. monothrix* is distinguished from those of species of *Sphaeronella* by the single seta on the trunk legs and caudal rami, the 2-merous 1st antenna, the absence of the 2nd antenna, and the distinctive structure of the 2nd maxilla and maxilliped. The number of seta on the trunk legs (which may be absent) varies from 0 (in *S. acanthozonis*) to 3 (in *S. frontalis*), with 2 being most common. Only in *S. capensis* and *S. gitanopsidis* do the legs have a single seta. The caudal rami of *Sphaeronella* may be absent or be armed with 0 (*S. acanthozonis*) to 5 (*S. leukarti*, of Green, 1958) setae, mostly frequently 2. A single seta is present in *S. gitanopsidis*, *S. holboelli*, and *S. acanthozonis*.

The 1st antenna is usually 3-merous in *Sphaeronella;* only *S. decorata* resembles *S. monothrix* in having a 2-merous 1st antenna with a long 1st segment. The 2nd antenna is absent in about 5 species, but present in most species of *Sphaeronella*. The maxillipeds are usually 4-merous, but are 3-merous in a few species.

The shape of the male body, with the nearly round head and narrow trunk is quite distinctive. Among the other characters that separate the male *S. monothrix* from species of *Sphaeronella* are the absence of hairs from the head except on the posterior parts of the lateral margins, and the absence of trunk legs.

Parasterope Poulsen, 1965

Parasterope pollex Kornicker, new species

FIGURES 4–7; PLATE 1*a,b*

Cylindroleberis mariae.—Cushman, 1906, p. 366, pl. 29 (figs. 19–25) [not Baird, 1850].

TYPES.—Holotype, gravid female, USNM 114048, from station 2906, Hadley Harbor, Mass., in alcohol. Allotype, adult male, USNM 114049, dissected on slides. Paratypes, 16 adult males, 62 females, 11 juveniles, USNM 114050–114059.

ETYMOLOGY.—The specific name "pollex," from the Latin noun meaning "thumb," refers to the thumblike dorsal process on the dorsum.

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Relationships.—In Poulsen's (1965, p. 316) key to the Asteropinae (=Cylindroleberinae), *P. pollex* falls between *Diasterope* and *Parasterope*. The female sensory bristle of the adult female 1st antenna has 6 long terminal filaments as in *Parasterope*, whereas the tip of the ventral branch of the mandibular coxale endite has several marginal spines, which makes it resemble more closely the coxale endite of *Diasterope* than of *Parasterope*. In order to include the species in *Parasterope*, it is necessary to expand the diagnosis given by Poulsen (1965, p. 362) to include species having several small spines near the tip of the ventral branch of the coxale endite.

Specimens interpreted as being male N–1 instars of *P. pollex* have a short proximal filament on the sensory branch of the 1st antenna. This character places the species close to the genus *Diasterope* and indicates the importance of having adult females available when classifying members of this subfamily.

Cypridina mariae Baird, 1850, was designated by Sylvester-Bradley (1961, p. 402) as the type-species of *Cylindroleberis*, which is the type-genus of the family Cylindroleberidae. The structure of the appendages of the unique holotype of *Cypridina mariae* from the Isle of Skye is unknown. Although the species has been identified from many areas by others, the identifications include several species and genera (see discussion by Skogsberg, 1920, pp. 518–522). Therefore, it is not possible to determine with certainty the genus in which the type-species belongs. Because of the relative instability of generic names in the family, especially in the subfamily Cylindroleberinae, the assignment of *P. pollex* to the genus *Parasterope* must be provisional.

Description of adult (figs. 4–6, 7*a–d;* pl. 1*a, b*).—Female shell (figs. 4*a, b, d–f;* pl. 1*a, b*): In lateral view oval, elongate, with greatest height slightly behind middle; in dorsal view with greatest width about midway between middle and posterior end; anterior and posterior margins evenly rounded; lateral surface smooth, with scattered normal pore canals, some with short hairs; incisur deep, narrow, with upper margin overlapping lower proximally; inner lamella with 40 to 42 medial bristles above incisur, 21 to 35 bristles below incisur, and about 10 bristles along ventral inner margin; medial ridge anterior to posterior margin with broad blunt spines interspersed with minute spines; about 27 spines in row between medial ridge and posterior margin; radial pore canals numerous, false radial pore canals sparse, containing hairs along posterior margin of shell; selvage narrow with fringe of hairs along anterodorsal margin; adductor muscle scars obscure, consisting of ovoid scars in cluster near middle of valves.

Male shell (figs. 4*c*, 6*f*, *g*): In lateral view suboval, with dorsal margin sloping posteriorly, gradually at first, and then more sharply, forming a posterodorsal angle; greatest height anterior to middle; in dorsal view greatest width anterior to middle; lateral surface smooth, with hairs in row across posterior region and sparsely distributed along ventral and posterior margins; incisur wider than in female, with rostrum projecting farther forward; inner lamella with about 42 medial bristles above incisur, 12 to 17 below incisur, and about 9 bristles along ventral margin; radial pore canals, and distribution of medial bristles on and posterior to medial ridge similar to female.

The numbers of medial bristles on the inner lamella above and below the incisur vary considerably within the species and on left and right valves of the same specimen. The numbers of bristles given in the description are for specimens on which they were counted, 2 females and 1 male. The average length of 51 adult females is 1.56 mm, average height 0.82 mm; the height calculated as percent of length is 53 percent. The average length of 8 adult males is 1.57 mm, average height is 0.86 mm; the height calculated as percent of length is 55 percent. Dimensions of shells of adult males and females are as follows:

FEMALES

USNM	*station*	*length mm*	*height mm*	*height as % of length*	*remarks*
114050	2906	1.46	0.79	54	parasitized
"	"	1.48	0.79	53	"
"	"	1.48	0.80	54	eggs in ovaries
"	"	1.59	0.82	52	ostracod eggs in brood chamber
"	"	1.58	0.84	53	" " " " "
"	"	1.43	0.76	53	" " " " "
"	"	1.62	0.87	54	" " " " "
"	"	1.51	0.81	54	parasitized
"	"	1.59	0.85	53	ostracod eggs in brood chamber
"	"	1.54	0.81	53	" " " " "
"	"	1.65	0.86	52	" " " " "
"	"	1.62	0.84	52	parasitized
"	"	1.41	0.75	53	"
"	"	1.47	0.77	52	"
"	"	1.46	0.76	52	"
"	"	1.51	0.80	53	"
"	"	1.56	0.86	55	eggs in ovaries
"	"	1.53	0.81	53	no eggs or parasites
"	"	1.60	0.86	54	" " " "
"	"	1.55	0.79	51	" " " "
"	"	1.55	0.84	54	ostracod eggs in brood chamber
"	"	1.56	0.82	53	" " " " "
"	"	1.58	0.84	53	" " " " "
"	"	1.62	0.83	51	" " " " "
"	"	1.61	0.89	55	" " " " "

FEMALES—continued

USNM	station	length mm	height mm	height as % of length	remarks
114050	2906	1.54	0.77	50	ostracod eggs in brood chamber
"	"	1.49	0.78	52	parasitized
"	"	1.64	0.87	53	ostracod eggs in brood chamber
"	"	1.59	–	–	" " " " "
"	"	1.49	–	–	parasitized
114048	"	1.61	0.89	55	ostracod eggs in brood chamber
114051	P. 1907	1.55	0.83	53	parasitized
"	"	1.66	0.87	52	"
"	"	1.51	0.78	52	"
"	"	1.58	0.84	53	"
"	"	1.52	0.82	54	"
"	"	1.62	0.87	55	"
"	"	1.60	0.87	54	ostracod eggs in brood chamber
"	"	1.46	0.78	53	parasitized
"	"	1.64	0.86	52	"
"	"	1.56	0.85	54	"
"	"	1.58	0.85	54	"
"	"	1.63	0.86	53	ostracod eggs in brood chamber
"	"	1.48	0.79	53	no eggs or parasites
"	"	1.56	0.81	52	1 ostracod egg in brood chamber
"	"	1.57	0.87	55	parasitized
"	"	1.58	0.84	53	"
114052	2207	1.56	0.83	53	no eggs or parasites
114053	276	1.54	0.79	51	eggs in ovaries
114054	1	1.62	0.84	52	" " "
"	1	1.48	0.79	53	ostracod eggs in brood pouch
114055	Great Harbor	1.64	0.83	51	" " " " " "
114056	6	1.65	0.84	51	eggs in ovaries
134057	7	1.68	0.87	52	13 ostracod eggs in brood chamber
					MALES
114049	2906	1.60	0.88	55	
114052	2207	1.58	0.85	54	
114051	1907	1.50	0.81	54	parasitized
"	"	1.54	0.84	55	
114050	2906	1.63	0.93	57	
"	2906	1.58	0.88	56	parasitized
114052	2207	1.62	0.87	54	
314056	6	1.54	0.84	54	

Female 1st antenna (figs. 4*g*, *h*): 1st joint with clusters of spines on medial surface; 2nd joint with 1 spinous dorsal bristle and clusters of spines on medial and lateral surfaces; 3rd and 4th joints fused; 3rd joint with 5 (rarely 4) spinous dorsal bristles, 1 short bare ventral bristle; 4th joint with 1 spinous dorsal and 2 bare ventral bristles; 5th joint with ventral sensory bristle with 6 terminal filaments, of these the 2 distal filaments are fused in the proximal half; 6th joint with long medial bristle with short marginal spines; 7th joint with

a-, b-, and c-bristles: a-bristle clawlike, b-bristle with 2 proximal and 2 distal filaments, c-bristle longer than b-bristle and with 5 filaments: 8th joint with e-, f-, and g-bristles: e-bristle bare, f-bristle with 3 spinous filaments near middle, and, distally, 2 filaments and spines, g-bristle with 4 to 5 filaments.

Male 1st antenna (fig. 6*h*): 1st joint with clusters of spines on medial surface; 2nd joint with 1 spinous dorsal bristle and clusters of spines on medial surface; 3rd joint with 6 spinous dorsal bristles and 1 short bare ventral bristle; 3rd separated from 4th joint by distinct suture; 4th joint with 1 spinous dorsal bristle and 2 bare slender ventral bristles; 5th joint with stout sensory bristle with numerous filaments; 6th joint with spinous medial bristle; 7th joint with a-, b-, and c-bristles: a-bristle clawlike, b-bristle with about 4 filaments, c-bristle extremely long and with about 24 filaments; 8th joint with e-, f-, and g-bristles: e-bristle bare, shorter than b-bristle; f-bristle extremely long and with 20 filaments; g-bristle with 8 filaments, longer than b-bristle.

Female 2nd antenna (figs. 4*i–k*): Protopodite with few hairs along dorsal margin and without bristle at base of endopodite. Endopodite weakly 3-jointed with bare terminal bristle. Exopodite 9-jointed: 1st elongate without bristle; 2nd to 9th joints short broad and decreasing in width distally; each of 2nd to 8th joints with short hairs in row along distolateral margin; 3rd to 8th joints each with small posterior and large anterior spine along distal margin; 9th joint with single lateral spine; bristle of 2nd joint reaching past 9th joint and with short marginal spines; bristles on 3rd to 8th joints with natatory hairs and denticulate along outer margins; 9th joint with 3 bristles: 1 short with spines, 1 long, and 1 medium with natatory hairs; long bristle denticulate along outer margin; short bristle with short marginal spines and occupying posterior position.

Male 2nd antenna (figs. 6*i–l*): Protopodite bare, larger than on female. Endopodite 3-jointed: 1st joint bare; 2nd joint with 3 bare bristles, 1 short, 2 medium; 3rd joint with finely annulated bristle proximally, and, distally, small tubercles in rows and 6 to 7 serrated terminal ridges. Exopodite larger than on female and without lateral spines on joints; 2nd joint more elongate than on female; each of 1st to 8th joints with clusters of short hairs distolaterally; bristles on 2nd to 9th joints with natatory hairs but without marginal denticulations; 9th joint with 4 bristles, 1 short, 1 medium, and 2 long.

Female mandible (figs. 5*a–i*): Exopodite 60 percent length of 1st endopodite joint, with 2 short distoventral bristles and hirsute terminal process. Endopodite: 1st joint with 3 long ventral bristles, 1 with short, and 2 with long spines; dorsal margin of 2nd joint with 4 long stout spinous a-, b-, c-, d-bristles and 5 additional bristles (proximal

bristle short, slender with few spines distally; between b- and c-bristles, 1 short and 1 medium spinous bristle; between c- and d-bristles, 1 long stout spinous bristle; following d-bristle, 1 medium slender spinous bristle); ventral margin of 2nd joint with 1 medium and 2 long spinous bristles; medial side near base of c-bristle with 4 to 5 unequal spinous bristles in row; end joint with 1 bare stout claw and 1 short and 4 long bristles. Basale endite with 4 (rarely 3) pectinate terminal bristles, 1 short bare bristle and 4 (rarely 3) triaenid bristles with 4 pairs of spines; glandular peg well developed; dorsal margin of basale with 2 slender terminal bristles with short spines. Coxale: ventral branch with long and short spines in roughly 4 transverse rows and several small spines or hairs near tip; dorsal branch: ventral margin with 6 rounded teeth and distally a crest of spines; terminal margin with short spines in row and slender terminal spine; dorsal margin with long slender hirsute spine near terminal end. (Distal part of dorsal branch of coxale missing on most specimens examined.)

The right mandible on a female examined is aberrant, having on the 2nd joint of the endopodite only 2 bristles on the dorsal margin, 2 on the ventral margin, and 2 on the medial surface (fig. 5*b*), and also in having 2 of the 3 ventral bristles on the 1st endopodite joint fused along their proximal ⅔; the 3rd bristle is bifurcate at the tip; the 2nd endopodite joint is almost ½ the length of the same joint on the normal left mandible; the end joint is larger than the end joint of the normal mandible and does not have a small medial bristle.

Male mandible (fig. 6*m*): 2nd joint of endopodite differs from female in having on dorsal margin 1 additional bristle proximal to a-bristle, and, on some specimens an additional short bristle between b- and c-bristles, and in greater spinosity of medial surface. Basale endite differs in having 4 to 7 pairs of spines on triaenid bristles compared to 4 on female.

Maxilla (figs. 5*j*, 7*a*): No sexual dimorphism. Epipodite pointed and hirsute. Proximal endite with 1 short and 3 long bristles; distal endite with 3 long bristles. Dorsal margin of basale hirsute, with 2 short bare bristles; ventral margin with short bare bristle near middle and long spinous distal bristle. Endopodite: 1st joint with 1 short bare anterior bristle and 1 medium terminal bristle; end joint with 1 long spinous bristle. Proximal spear-shaped bristle of baleen comb longer than adjacent oar-formed bristles.

5th limb (figs. 5*k*, *l*): No sexual dimorphism. Form of appendage typical for genus. Epipodial appendage with 59 to 60 marginal

bristles. Anterodorsal margin of comb with about 6 long hairs. Proximal end of comb with sclerotized dorsally oriented process.

6th limb (fig. 5*m*): No sexual dimorphism. Anterior margin concave, with 2 slender bristles; medial side with small proximal spine near anterior margin; anterior corner with 2 plumose bristles, followed by 12 to 17 (rarely 10) spinous posteroventral bristles; anterior part of ventral margin, posterior margin, and medial surface hirsute; lateral anterior flap with fringe of hairs anteriorly.

The number of bristles along the ventral and posterior margins of the 6th limbs and shell lengths of selected specimens are as follows:

		number of bristles		
sex	*station*	*left limb*	*right limb*	*carapace length*
♀	2906	14	15	1.61
♀	2906	15	15	1.59
♀	2906	13	13	1.41
♀	1907	17	17	1.55
♀	1907	15	16	1.66
♂	2906	12	14	1.60
♂	1907	16	16	1.54
♂	1907	15	15	1.50
♀	6	17	16	1.65
♀	7	12	10	1.68
♀	1	15	16	1.62

7th limb (figs. 5*n–p*): 6 cleaning bristles in proximal group, 6 in distal group; each bristle with 2 to 4 distal bells; tips of cleaning bristles spinous. Terminal comb with 12 to 13 pinnate teeth on each side. Male and female similar.

Furca (figs 6*a*, *b*): Each lamella with 6 curved claws with pointed tips, followed by 2 to 3 spinous bristles; convex and concave margins of claws with large and small spines in row distally; spinous bristles decreasing in length proximally on lamella. Furca similar in male and female.

Rod-shaped organ (figs. 5*q*, 7*b*): Elongate, similar in male and female.

Medial eye (figs. 5*q*, 7*b*): Eye well developed and with clusters of hairs dorsally. Similar in male and female.

Lateral eyes: Each eye of female (fig. 6*c*) about ½ diameter of medial eye and with about 6 undivided ommatidia. Male eye (fig. 7*d*) similar in size to medial eye and considerably larger than lateral eye of female; about 16 divided ommatidia present.

Lips (fig. 6*e*): No sexual dimorphism. Upper lip: Central lobe with a hirsute lateral lobe on each side; each lobe with anterior

spine, spine on central lobe smaller than spines on lateral lobes; narrow canal extending into spines on lateral lobes.

Lower lip: Hirsute, rounded, consisting of 2 lobes, each smaller than lateral lobe of upper lip.

Copulatory organs: Female genital organs ill defined. Male copulatory limbs well developed, each having 2 elongate lobes with 1 to 2 bristles (fig. 7*c*).

Dorsum (fig. 6*d*): Margin ventral to dorsal process with fine hairs; dorsal process finger-like, hirsute. Male and female similar.

Description of N–1 male instar (figs. 7*e–m*). Shell (figs. 7*e, f*) in lateral outline similar to adult female. 1st antenna (fig. 7*g*) similar to that of adult female with following exceptions: 3rd joint with 6 dorsal bristles; sensory bristle on 5th joint with short filament proximal to 6 terminal filaments. 2nd antenna: Exopodite similar to that of female; endopodite 3-jointed with 3rd joint weakly separated from 2nd: 1st joint bare; 2nd joint with 2 short bristles; 3rd joint with proximal bristle. Mandible (figs. 7*i, k*) 5th, 6th, and 7th limbs, upper and lower lips, rod-shaped organ and medial eye (fig. 7*l*), furca and dorsal process similar to adult female. Lateral eyes (fig. 7*m*) similar to those of adult male except with smaller ommatidia. Dimensions of carapaces of N–1 male instars are as follows:

USNM	*station*	*length mm*	*height mm*	*height as % of length*	*remarks*
114050	2906	1.42	0.80	57	
114058	Coll. 2	1.43	0.73	51	
114053	276	1.38	0.72	52	
114052	2207	1.38	0.75	54	
114059	Coll. 4	1.43	0.77	54	parasitized

Several juvenile males differed from N–1 males described above in being larger and in having numerous filaments on the sensory bristle on the 5th joint of the 1st antenna. These specimens appear to have continued to molt after reaching the N–1 stage described above without acquiring all characters of the adult male. Dimensions of 3 specimens are as follows:

USNM	*station*	*length mm*	*height mm*	*height as % of length*
114050	2906	1.72	0.96	56
	2906	1.56	0.84	54
114054	1	1.70	0.93	55

It is suggested that the occurrence of unusually large specimens of an ostracod species occasionally reported in the literature and generally attributed to postadult molting may be caused instead by delay of sexual maturity.

Measurements of shells of some of the smaller juveniles in the collection are as follows:

USNM	station	length mm	height mm	height as % of length	sex
114060	260	1.02	0.57	56	not determined
114053	276	0.98	0.53	54	"
"	276	0.99	0.50	51	"
"	"	0.84	0.46	55	"
"	"	0.86	0.48	56	"
"	"	1.01	0.57	56	"
"	"	0.83	0.44	53	"
114050	2906	1.15	0.67	58	♀
"	"	1.08	0.61	56	♀
"	"	1.14	0.61	54	♀
"	"	1.17	0.64	55	♀?
"	"	1.27	0.74	58	♂[a]

[a]Seven filaments on sensory bristle of 1st antenna.

COMPARISONS.—With the exception of *Parasterope corrugata* Poulsen, 1965, the 8 species of *Parasterope* listed by Poulsen (1965, table 17, pp. 310–311) do not have the thumblike dorsal process that is present on the dorsum of *P. pollex*. *Parasterope pollex* differs from *P. corrugata* in having 12 to 17 bristles along the posteroventral margin of the 6th limb compared to about 3 on *P. corrugata*, and in having 2 ventrodistal bristles on the 4th joint of the 1st antenna compared to no bristles on *P. corrugata*. *Parasterope pollex* differs from *Cylindroleberis psitticina* Darby, 1965, in having only 2 bristles on the anterior corner of the 6th appendage compared to 6 on *C. psitticina*, and in having no laterodistal bristle on the 1st joint of the 1st antenna. The adult female of *C. psitticina* has 6 dorsal bristles on the 3rd joint of the 1st antenna compared to only 5 on *P. pollex*.

The appendages of *Cypridina mariae* Baird, 1850, are unknown. The unique dried holotype (no. 1945, 9.26, 96–100) is in the Baird Collection at the British Museum (Natural History). Miss Patricia D. Lofthouse of the Entomostraca Section of the British Museum on request kindly measured the length of the specimen and found it to be 2.33 mm, considerably longer than adults of *P. pollex*. The length of the adult female identified as *Asterope mariae* (Baird) by Brady and Norman (1896, p. 630) is 2.4 mm. Brady and Norman (1896, pl. LI: fig. 7) illustrate the 6th limb as having 4 anteroventral and 25 posteroventral bristles, many more than are present on *P. pollex*.

Appendages of specimens from San Diego Bay, Calif., identified as *Cylindroleberis oblonga* (Grube, 1859) by Sharpe (1908, p. 423, pl.

LXII: figs. 1–4) are incompletely known, but lateral outline of the shell is more acuminate anteriorly than that of *P. pollex*. Unfortunately, specimens identified by Sharpe (USNM 13108) are missing from the museum collection, so that appendages could not be examined. Specimens from off the California coast identified as *Cylindroleberis mariae* (Baird) by Juday (1907, p. 143) are described incompletely, but, according to the description of the furca (Juday, 1907, p. 144), each lamella bears 10 claws; it thus differs from the furca of *P. pollex*, which has only 8 to 9 claws on each lamella.

Cyridina oblonga Grube (1859, p. 335) has only 11 bristles on the 7th limb and no bristles on the anterior corner of the 6th limb (Grube, 1859, pl. XII: fig. E). Specimens identified as *Cylindroleberis oblonga* (Grube) by Müller (1894, p. 219) differ from *P. pollex* in having 25 posteroventral and 4 anteroventral bristles on the 6th limb (Müller, 1894, pl. 5: fig. 33). Specimens identified as *Asterope oblonga* (Grube) by Sars (1887, p. 203) have a 6th limb with 24 posteroventral and 6 anteroventral bristles (Sars, 1887, pl. 5: fig. 10). Specimens identified as *Cylindroleberis mariae* (Baird) by Brady (1868, p. 465) have 6 anteroventral bristles on the 6th limb (Brady, 1868, pl. 41: fig. 1f); the 3rd joint of the 1st antenna of the adult female of Brady's specimens has 6 dorsal bristles (pl. 41: fig. 1c) compared to 5 on *P. pollex*.

Specimens identified by Sars (1887, p. 203) as *Asterope elliptica* Philippi have about 24 posteroventral and 5 to 6 anteroventral bristles on the 6th limb (Sars, 1887, pl. IV: fig. 1). *Asteropina extrachelata* Kornicker (1959, p. 241) has on the 6th limb 24 posteroventral and 4 anteroventral bristles. *Asteropina setisparsa* Kornicker (1959, p. 239) has only 1 posteroventral bristle and 3 anteroventral bristles on the 6th limb. The carapaces of the adult male and female of *Asterope judayi* Hartmann (1959, p. 201) are shorter than *P. pollex*, and the height of the female shell is 62 percent of its length, according to Poulsen (1965, p. 347), who estimated it from Hartmann's figure (Hartmann, 1959, pl. 33: fig. 32). The height of the female shell of *P. pollex* is only 51 to 55 percent of its length.

The N–1 instar of the male of *P. pollex* resembles *Diasterope tenuista* Poulsen, 1965, of which only the juvenile male is known. It differs from that species in having a thumblike posterior process and slender c- and d-bristles on the 2nd endopodite joint of the mandible.

Cushman (1906, p. 366) identified specimens collected in the "Gulf of Canso" across from Woods Hole, Mass., on Aug. 3, 1905, as *Cylindroleberis mariae* (Baird). The USNM contains in its collection a slide containing 4 dried ostracods (USMN 114061) labeled "*Cylindroleberis mariae* Baird, Aug. 3, '05, Gulf of Canso, Woods Hole, Mass., Coll. by J. A. Cushman." One of the 4 is an adult male and another an adult female with 10 ostracod eggs in its brood chamber.

The female was soaked in glycerin and its appendages examined and found to be identical to the female of *P. pollex*. Therefore, *C. mariae* (Baird) of Cushman, 1906, not of Baird, 1850, is placed in synonomy with *P. pollex*. The description of specimens from the "Gulf of Canso" published by Cushman (1906, p. 366, pl. 29: figs. 19–25) differs considerably from *P. pollex*. Two glass slides containing mounted ostracod appendages are in the Cushman Collection at the USNM. One of these is labeled "*Asterope teres* (Norman) ♂, Woods Hole, Mass., Aug. 3, '05, (USNM 114062)"; the other is labeled "*Asterope teres* (Norman) ♀, Woods Hole, Mass., Aug. 3, '05 (USNM 114063)." Because of the locality and collection date of the specimens and because Cushman (1906) did not report the presence of *A. teres* in his publication, it is probable that the slides contain the specimen upon which Cushman based his description of *C. mariae*. Both specimens are identifiable as *P. pollex*. The specimen labeled "♀" on the slide is actually a juvenile male and this accounts for some of the differences between Cushman's description of the "female" of *C. mariae* and the female of *P. pollex*, i.e., the presence of 6 dorsal bristles on the 3rd joint of the 1st antenna (Cushman, 1906, pl. 29: fig. 22) and also a total of only 7 claws and bristles on the left lamella of the furca (loc. cit., fig. 25). No explanation is available for the presence of 2 slender bristles proximal to the a-bristle on the 2nd endopodite joint of the mandible (loc. cit., fig. 24). Two bristles in this position were observed only on the adult male of *P. pollex*. They are present on the male of *C. mariae* on Cushman's slide but not on the "female." Cushman (1906, p. 367) gives the length of the male shell as 1.8 to 2 mm, considerably larger than adult males of *P. pollex*. Because of the dried condition of the available specimens, their length can not be accurately measured. An adult female soaked in glycerine measured only 1.43 mm long, 0.78 mm high. The length of the dried male in the Cushman Collection is only 1.27 mm in its shriveled condition.

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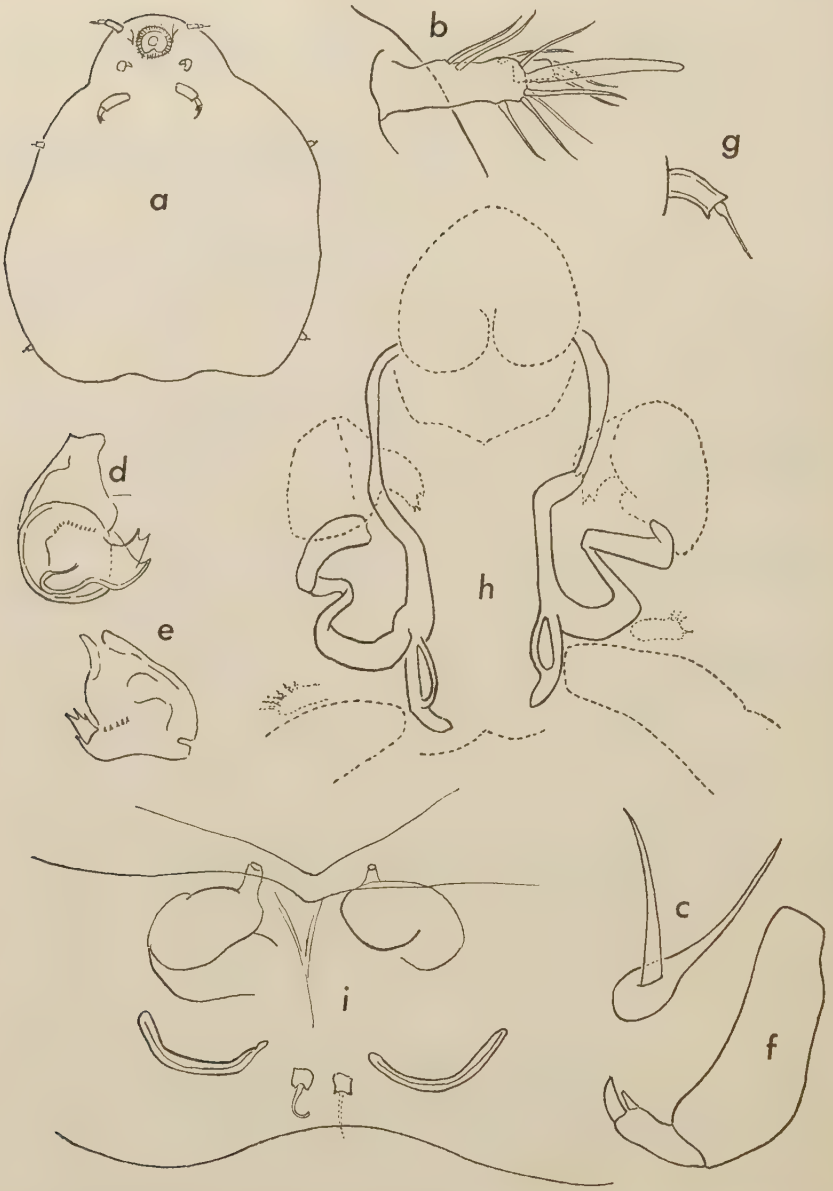

FIGURE 1.—*Sphaeronellopsis monothrix* Bowman and Kornicker, female: *a*, holotype, ventral aspect; *b*, 1st antenna; *c*, 1st maxilla; *d*,*e*, 2 views of 2nd maxilla; *f*, maxilliped; *g*, posterior trunk leg; *h*, submedian skeleton; *i*, genital area.

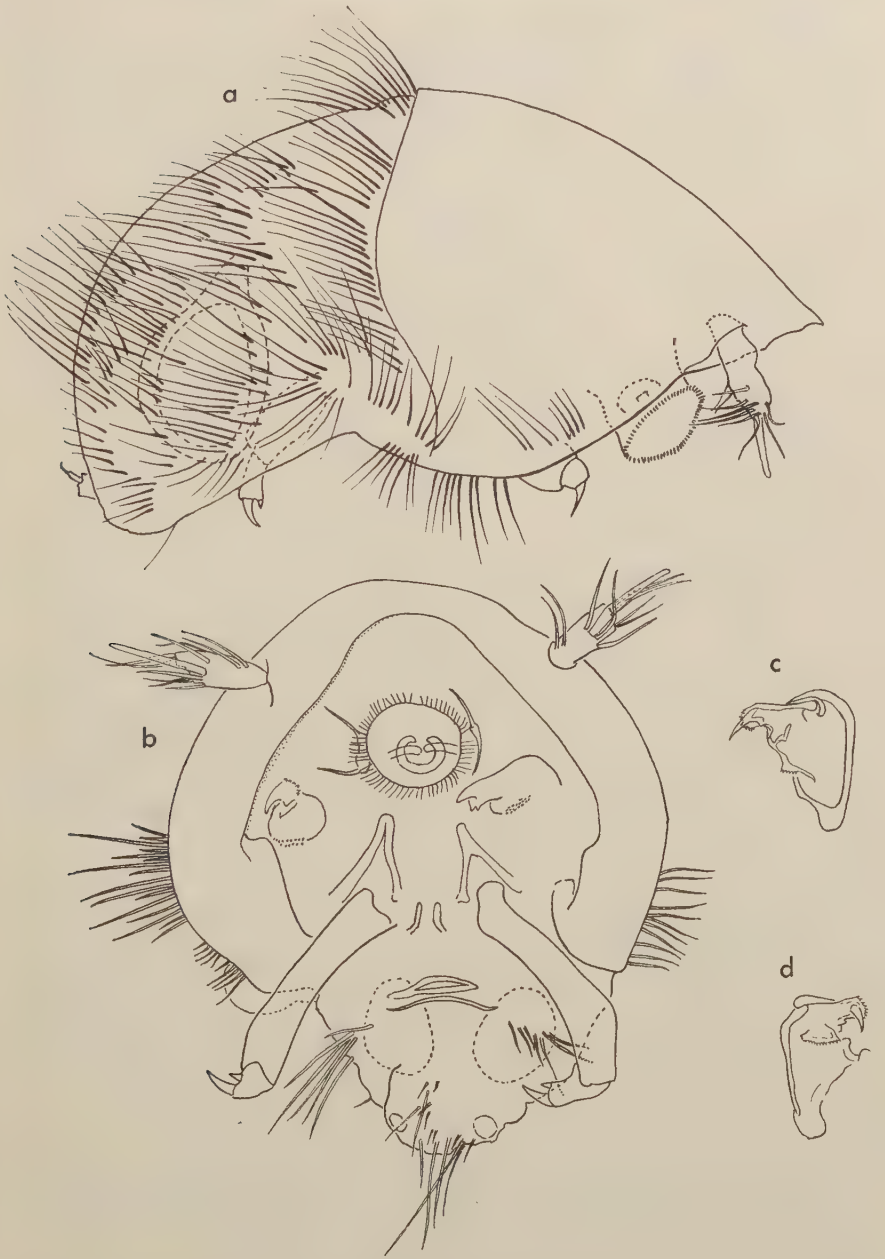

FIGURE 2.—*Sphaeronellopsis monothrix* Bowman and Kornicker, male: *a*, lateral aspect; *b*, ventral aspect; *c,d*, 2 views of 2nd maxilla.

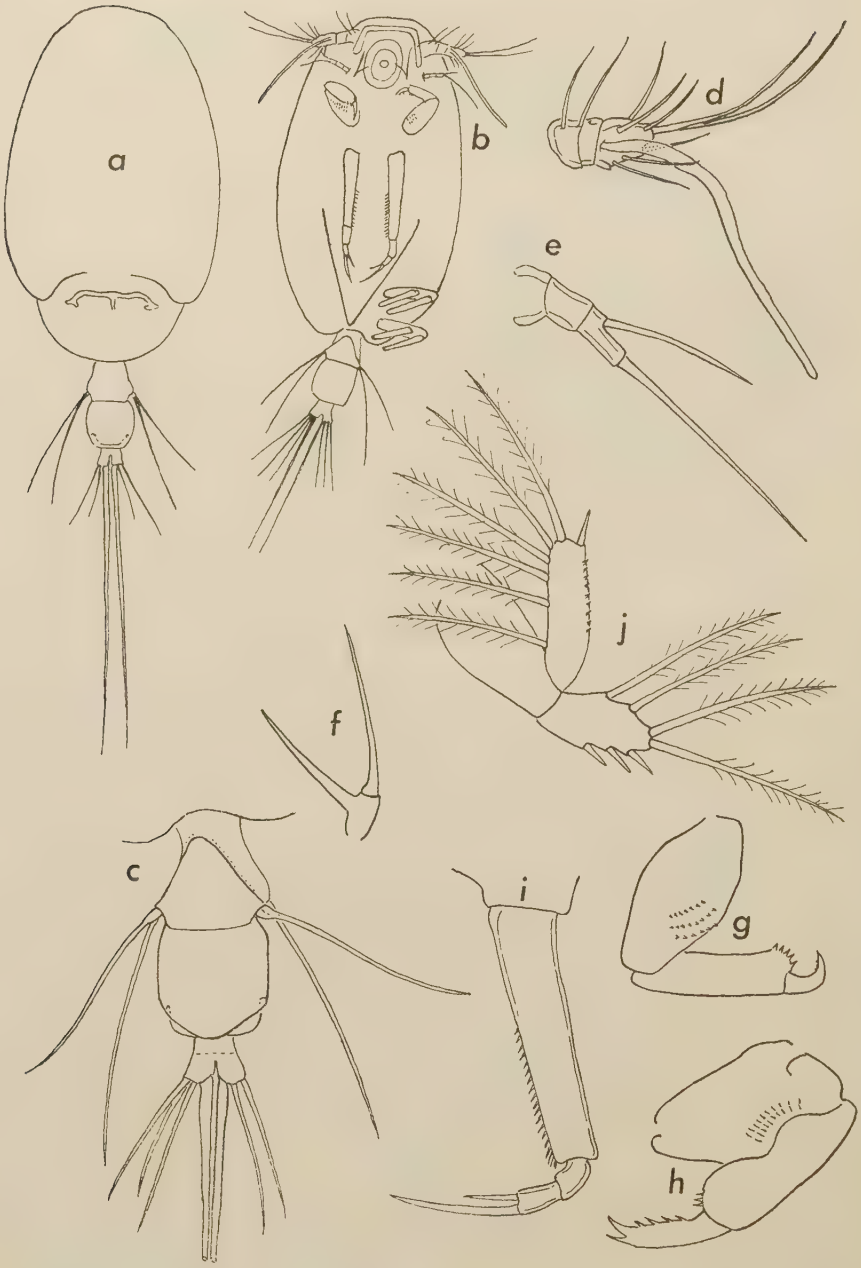

FIGURE 3.—*Sphaeronellopsis monothrix* Bowman and Kornicker, copepodid: *a*, dorsal aspect; *b*, ventral aspect; *c*, urosome, ventral; *d*, 1st antenna; *e*, 2nd antenna; *f*, 1st maxilla; *g*,*h*, 2 views of 2nd maxilla; *i*, maxilliped; *j*, posterior trunk leg.

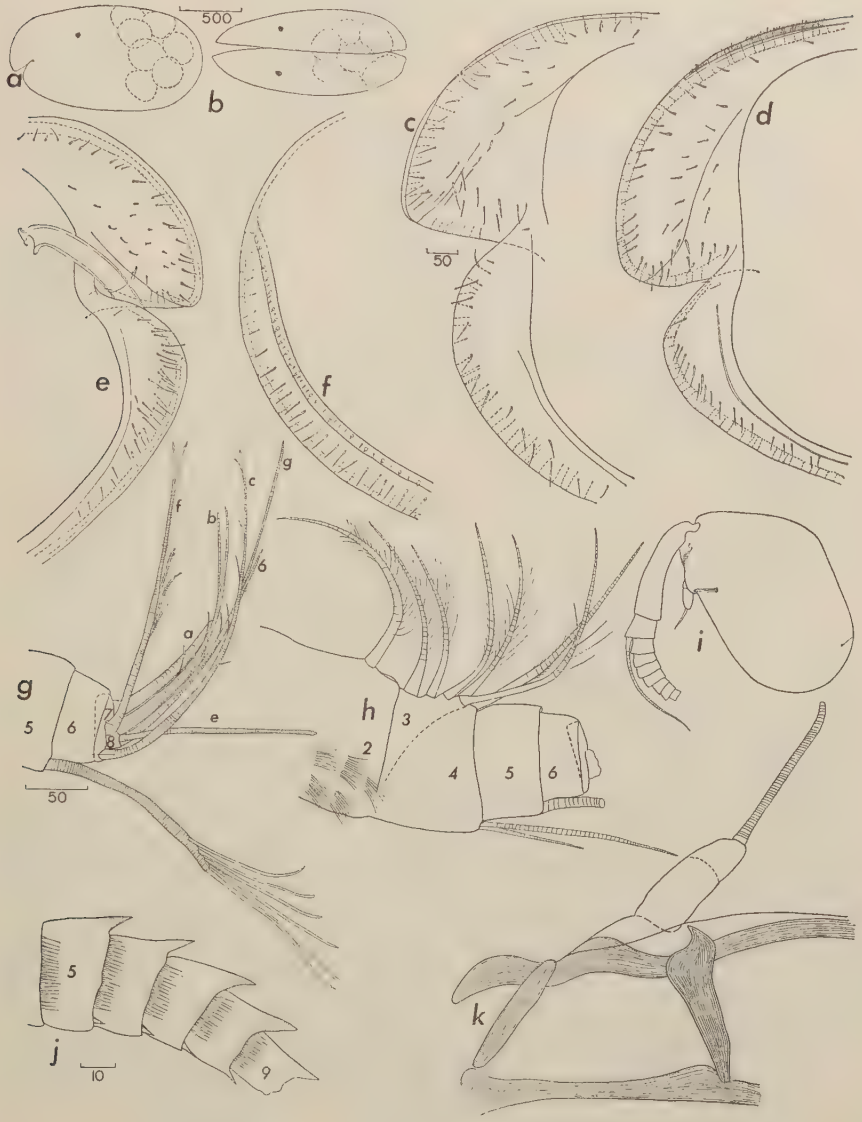

FIGURE 4.—*Parasterope pollex* Kornicker, carapace of holotype: *a*, lateral view; *b*, dorsal view; *c*, inside anterior right valve of allotype; *d*, inside anterior right valve of holotype. Female: *e*, inside anterior left valve with 2nd antenna through sinus; *f*, inside posterior left valve. 1st antenna, lateral view: *g*, joints 5–8; *h*, joints 2–8. 2nd antenna: *i*, medial view (bristles on joints 3–9 of exopodite not shown); *j*, joints 5–9 of exopodite, lateral view (bristles not shown); *k*, endopodite medial view. (Same scale in microns: *a*, *b*; *c–f*, *i*; *g*, *h*; *j*, *k*.)

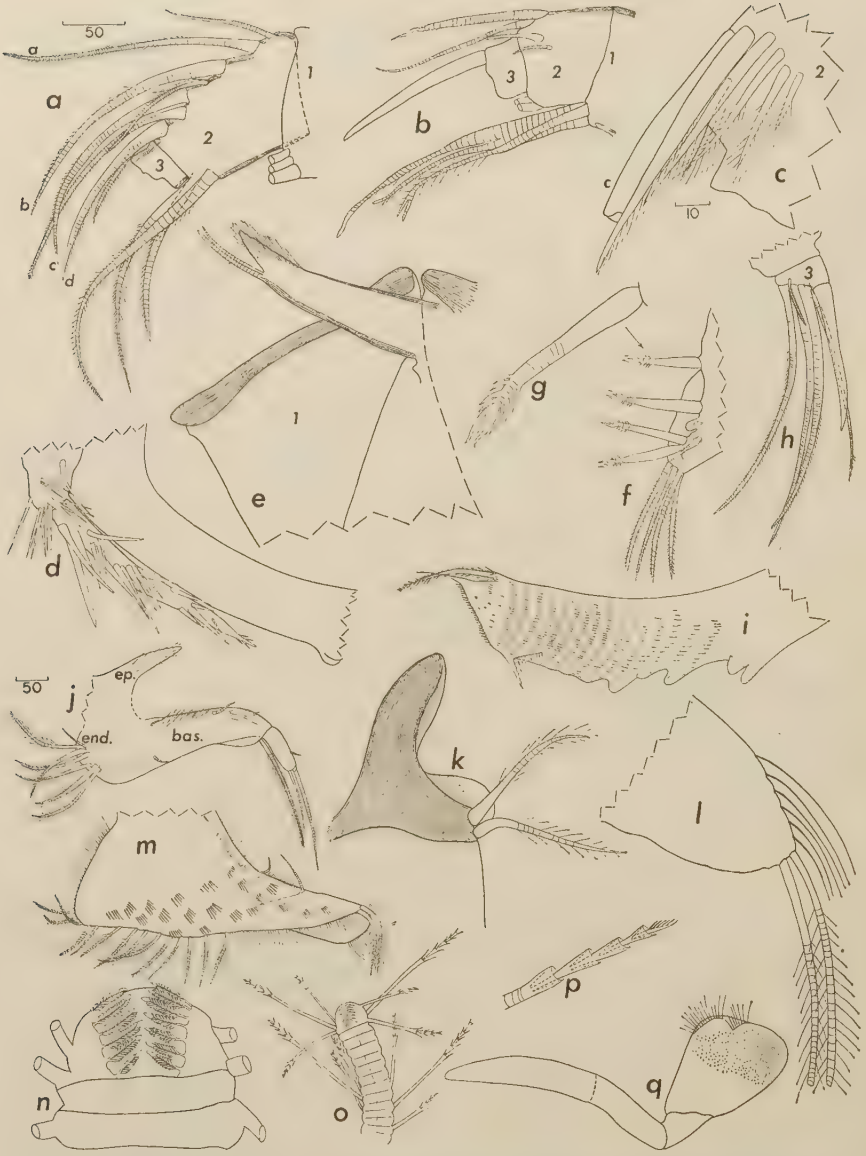

FIGURE 5.—*Parasterope pollex* Kornicker, female, mandible: *a*, bristles on joint 2 of endopodite, lateral view; *b*, joint 2 of abnormal mandible, medial view; *c*, medial bristles on 2nd joint of normal mandible; *d*, ventral branch of falciform process, medial view; *e*, exopodite, lateral view; *f*, basal endite, medial view; *g*, enlargement of triaenid bristle; *h*, end joint of endopodite, medial view; *i*, distal part dorsal branch of falciform process, medial view; *j*, maxilla (baleen-comb not shown). 5th limb: *k*, sclerotized process and bristles at proximal end of comb; *l*, distal end of comb (only 2 bristles of comb shown); *m*, 6th limb, medial view. 7th limb: *n*, terminal comb; *o*, distal part; *p*, detail of bells on bristle; *q*, rod-shaped organ and medial eye. (Same scale in microns: *a*, *b*, *f*, *h*, *q*; *c–e*, *g*, *i*, *k*, *l*, *n*, *p*; *j*, *m*, *o*.)

FIGURE 6.—*Parasterope pollex* Kornicker, female, furca: *a*, right lamella, medial view; *b*, enlargement of claw 1, distal part; *c*, lateral eye; *d*, dorsum with dorsal process (dotted circles = oil globules); *e*, frontal region showing lips, lateral view (compressed under cover glass). Male allotype, carapace: *f*, lateral view; *g*, dorsal view; *h*, 1st antenna, medial view. 2nd antenna: *i*, lateral view (bristles on exopodite joints 3–9 not shown; bristle broken on end joint of endopodite); *j*, hairs on distal end of 1st exopodite joint, lateral view; *k*, endopodite, medial view; *l*, enlargement of tip of 3rd joint of endopodite; *m*, mandible bristles on 2nd endopodite joint, medial view. (Same scale in microns: *a*, *c–e*, *m*; *b*, *j*, *l*; *h*, *i*, *k*; *f*, *g*.)

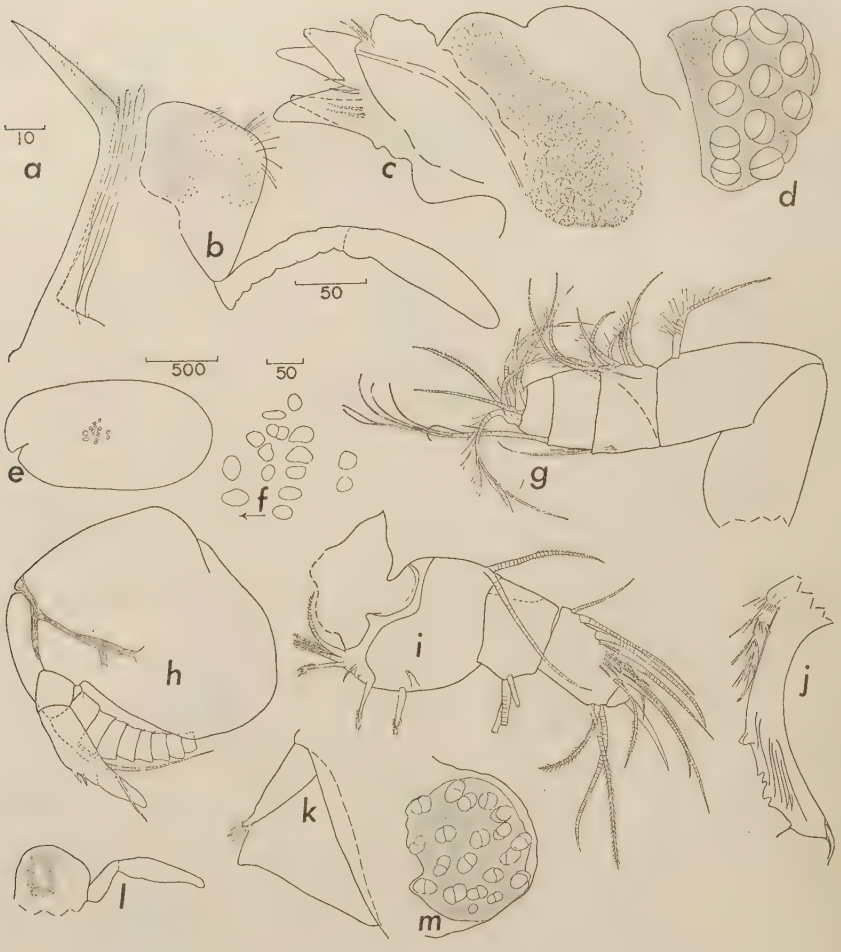

FIGURE 7.—*Parasterope pollex* Kornicker, male allotype: *a*, maxilla, spear-shaped bristle and 3 proximal bristles on baleen-comb; *b*, medial eye and rod-shaped organ; *c*, copulatory organ; *d*, lateral eye. Male N–1 instar: *e*, carapace, lateral view; *f*, enlargement of muscle scars, lateral view; *g*, 1st antenna, lateral view; *h*, 2nd antenna, medial view (basal spines and bristles of joints 3–9 not shown on exopodite); mandible: *i*, medial view (only end claw shown on 3rd endopodite joint); *j*, falciform process, medial view; *k*, exopodite lateral view; *l*, medial eye and rod-shaped organ; *m*, lateral eye. (Same scale in microns: *a; b–d, j, k, m; f–i, l; e.*)

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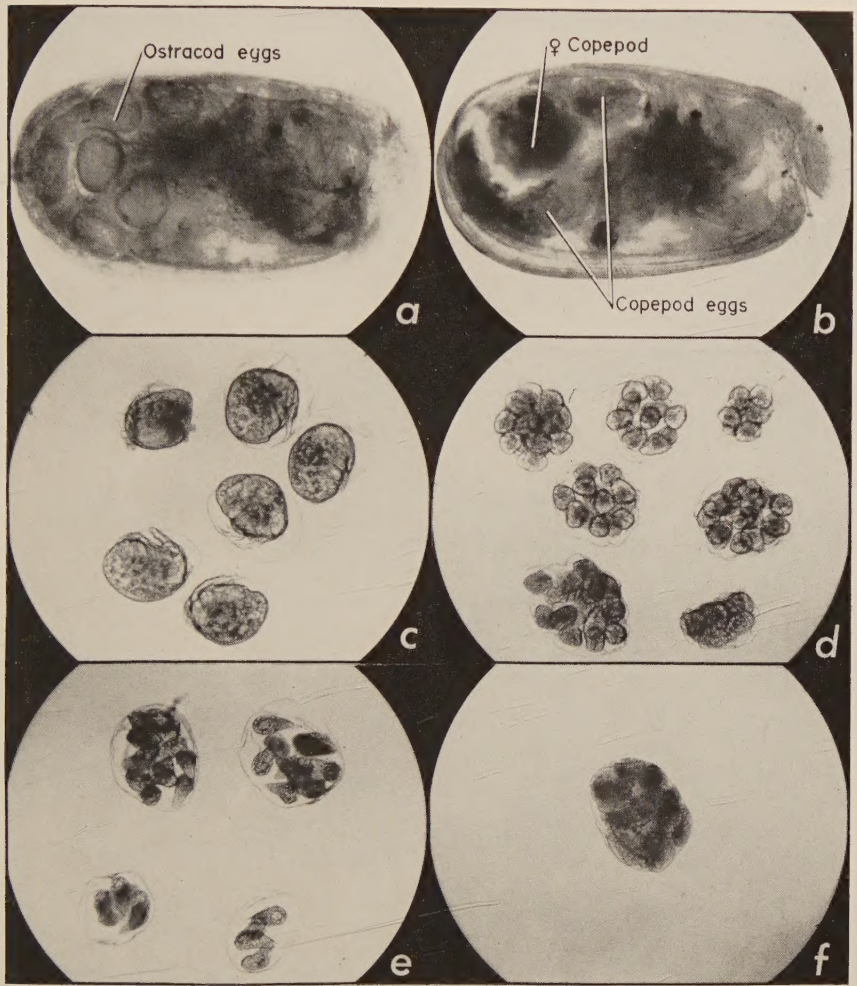

Parasterope pollex Kornicker: *a*, ovigerous female, lateral; *b*, parasitized adult female, lateral; *c*, eggs. *Sphaeronellopsis monothrix*, ovisacs, showing 3 developmental stages: *d*, round eggs; *e*, pyriform eggs; *f*, copepodids. (*a*, *b*: 34×; *c–f*: 44×.)